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09/982,086	10/19/2001	Jeong-kwan Lee	1293.1270	6758

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EXAMINER
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GEBREMARIAM, SAMUEL A

ART UNIT	PAPER NUMBER
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2811

DATE MAILED: 05/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/982,086

Applicant(s)

LEE ET AL.

Examiner

Samuel A. Gebremariam

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 17 October 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-64 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-64 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>9/01/05, 1/30/04</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Response to Appeal brief*

1. In view of the appeal brief filed on 10/17/2005, PROSECUTION IS HEREBY REOPENED. A new ground of rejection is set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-26 and 28-64 are rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al., EP 1035423.

Regarding claim 1 Lee teaches (figs. 6 and 7) a vertical cavity surface emitting laser (VCSEL) comprising: a substrate (100); a lower reflector (110) formed on the substrate (100); an active layer (120) formed on the lower reflector (110), generating light by a recombination of electrons and holes (inherent characteristics of the device, refer to paragraph 0063); an upper reflector (140) formed on the active layer (120) comprising a lower reflectivity than that of the lower reflector, a micro-lens (155) comprising a single convex surface (fig. 6) disposed in a window region (180) having an arch extending through the entire window region through which the laser beam is emitted (fig. 6); a lens layer (150) formed on the upper reflector (140) with a transparent material transmitting a laser beam, the lens layer (150) comprising the micro-lens (155); an upper electrode (160) formed above the upper reflector (140) excluding the window region (180); and a lower electrode (170) formed underneath the substrate (100).

The limitation of "laser beam is emitted to collimate the laser beam" is not given patentable weight. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. Furthermore since Lee teaches a microlens structure (155) with a convex surface, Lee's structure is inherently capable of collimating the laser beam across the entire window region.

Regarding claim 2, Lee teaches the entire structure of claim 1 above including the VCSEL satisfies a following relationship:  $f = R \times n_1 / (n_2 - n_1)$  where  $f$  is a distance along an optical axis from a light generating region of the active layer to a vertex of the micro-

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lens,  $R$  is a radius of curvature of the micro-lens,  $n_1$  is an effective refractive index of a medium on an optical path between the light generating region and the lens layer, and  $n_2$  is a refractive index of a region towards which a light is emitted through the micro-lens. Since Lee's structure is identical to the claimed invention the VCSEL structure of Lee inherently satisfies the above relationship.

Regarding claims 3, 5 and 11, APA teaches substantially the entire structure of claim 1 above including a high-resistance region (130) between the upper (140) and lower (110) reflectors relatively close to the active layer (120), the high-resistance region having an aperture at a center thereof through which a current flows (fig. 6),

The limitation that the micro-lens is formed by diffusion-limited etching is considered a product-by-process claim. "[E]ven though product-by process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). Furthermore Lee teaches that the micro-lens is formed by diffusion-limited etching (0071).

Regarding claims 4, 10 and 21, Lee teaches the entire structure of claim 1 above including the lens layer is formed of a material comprising at least one of silicon and a III-V compound semiconductor, wherein the III-V compound semiconductor comprises one of indium phosphide (InP), gallium arsenide (GaAs), indium arsenide (InAs), gallium

phosphide (GaP), indium gallium phosphide (InGaP), indium gallium arsenide (InGaAs), and aluminum gallium arsenide (AlGaAs), the material comprising a relatively large bandgap to a wavelength of the laser beam so as not to absorb the laser beam (0059).

Regarding claims 6, 7 and 23-26, Lee teaches the entire structure of claims 1-3 above including the window region comprises a maximum width smaller than a size of light generated in the active layer emitted towards the window region, satisfying a Fraunhofer diffraction condition occurring in the window region is offset by a focusing power of the micro-lens, where the maximum width of the window region D and a focal length f of the micro-lens satisfy a relation:

$$D = (2 \times 1.22 \Sigma f)^{1/2}$$
 where k, is a wavelength of the laser beam emitted from the VCSEL.

Since Lee's structure is identical to the claimed device the structure of Lee satisfies the Fraunhofer diffraction condition as claimed.

The limitation of "laser beam is emitted to collimate the laser beam across the window to emit a parallel light beam" is not given patentable weight. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. Furthermore since Lee teaches a microlens structure (155) with a convex surface, Lee's structure is inherently capable of collimating the laser beam across the entire window region.

Regarding claims 8 and 9, Lee teaches the entire structure of claim 1 including that the high-resistance region according to claims 6 and 7, between the upper and lower reflectors, relatively close to the active layer, the high-resistance region comprising an aperture at a center thereof through which a current flows, the aperture of the high-resistance region comprising a maximum width greater than or approximately equal to the maximum width of the window region.

Regarding claims 12-15, 16, 17-21 and 22, Lee teaches the entire structure of claims 1-4, 5, 6-10 and 11, above including a micro-fens built-in vertical cavity surface emitting laser (VCSEL) comprising: a micro-lens (205) disposed in a window region (280) and comprising a single convex surface having an arch extending through the entire window region (fig. 7) through which a laser beam is emitted to; a substrate (200) comprising a transparent material transmitting the laser beam, the substrate comprising the micro-lens; a lower reflector (210) formed on the substrate, an active layer (120) formed on the lower reflector, generating light by recombination of electrons and holes; an upper reflector (240) formed on the active layer comprising a higher reflectivity than that of the lower reflector; an upper electrode (250) formed on the upper reflector; and a lower electrode (270) formed on a portion of the substrate (200) excluding the window region (280) through which the laser beam is emitted (fig. 7).

The limitation of "laser beam is emitted to collimate the laser beam" is not given patentable weight. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is

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capable of performing the intended use, then it meets the claim. Furthermore since Lee teaches a microlens structure (205) with a convex surface, Lee's structure is inherently capable of collimating the laser beam across the entire window region.

Regarding claim 28, Lee teaches substantially the entire claimed structure of claims 1-3, 5, 6-9 and 23 including the micro-lens lies along a central optical axis of the light beam emitted from the VCSEL (fig. 6).

Regarding claims 29-31 and 32, Lee teaches substantially the entire claimed structure of claims 1-3, 5, 6-10 and 23 including the lower reflector (110), the active layer (120), and the upper reflector (140) are sequentially stacked on the substrate, the lower reflector and the upper reflector are formed of alternating semiconductor compounds comprising different refractive indexes and the lower reflector is doped with the same n-type impurities and the upper reflector is doped with p-type impurities (fig. 6, paragraph 0052).

Regarding claim 33, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9 and 23 including the active layer (120) is formed of GaAs according to a wavelength of the light beam (fig. 6, paragraph 0054).

Regarding claims 34 and 36, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9 and 23 above the high-resistance region comprising an aperture at a center thereof through which current applied through the upper electrode flows and high-resistance region is formed by implantations of ions or by selective oxidation in a region of the upper reflector and the micro-lens comprises a convex surface formed by diffusion-limited etching (paragraph 0055).



Furthermore the limitations that the high resistance as claimed is formed by implantation of ions or selective oxidation and the micro-lens is formed by diffusion-limited etching are considered a product-by-process claim. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

Regarding claim 35, Lee teaches the entire claimed structure of claim 24 above including the lens layer comprises a thickness of several micrometers (paragraph 0056).

Regarding claim 37, Lee teaches the entire claimed structure of claims 1 and 24 including the upper electrode is formed on top of the lens layer (fig. 6).

Regarding claims 38–40, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9 and 23 including that the distance along an optical axis from the light generating region to a vertex of the micro-lens is equal to a focal length of the micro-lens where the VCSEL satisfies a following relationship:  $f = R \cdot n_1 / (n_2 - n_1)$  where  $f$  is a distance along an optical axis from the light generating region to the vertex of the micro-lens,  $R$  is a radius of curvature of the micro-lens,  $n_1$  is an effective refractive index of a medium on an optical path between the light generating region and the lens layer, and  $n_2$  is a refractive index of a region toward which the light beam is emitted through the micro-lens; and the VCSEL also satisfies a following relationship:  $n_1 / S_1 + n_2 / S_2 = (n_2 - n_1) / R$  where

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S1 is a distance from the light generating region of the active layer to a vertex of the micro-lens on the optical axis, S2 is a distance from the vertex of the micro-lens to a second focal point of the micro-lens,  $n_1$  is an effective refractive index of the medium from the upper reflector and the lens layer, and  $n_2$  is a refractive index of a region toward which the light beam emitted through the micro-lens travels. Since Lee's structure is identical to the claimed invention the VCSEL structure of Lee, inherently satisfies the above relationships. Furthermore Lee teaches the same structure as the claimed invention, Lee inherently teaches the limitation that the distance along an optical axis from the light-generating region to a vertex of the micro-lens is equal to a focal length of the micro-lens.

Regarding claim 41, Lee teaches the entire claimed structure of claim 24 above including a forward biased current is applied to the micro-lens built-in VCSEL through the upper and lower electrodes, the light beam comprising a particular wavelength through laser oscillation is transmitted through the upper reflector and the lens layer and is condensed by the micro-lens and emitted as the parallel laser beam (paragraph 0063).

Regarding claim 42, Lee teaches the entire claimed structure of claim 23 above including the VCSEL is a top emitting type VCSEL (fig. 6).

Regarding claims 43-46, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12 and 23 above including the micro-lens is formed in the window region of the substrate through which the light beam is condensed and emitted (paragraph 0060).

Regarding claims 47-48, APA teaches substantially the entire claimed structure of claims 1-4, 5, 6-10, 12 and 23 above including that when a number of stacked layers of the lower reflector is smaller than that of the upper reflector, the reflectivity of the lower reflector is lower than that of the upper reflector and most of the laser beam is emitted through the lower reflector (paragraph 0050).

Regarding claims 49-50, Lee teaches substantially the entire claimed structure of claims 1-4, 5, 6-10, 12 and 23 above including the lower reflector and the upper reflector are formed of alternating semiconductor compounds comprising different refractive indexes (paragraphs 0049 and 0050).

Regarding claim 51, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12 and 23 above including the VCSEL satisfies a following relationship:  $f = R'n_1'/(n_2'-n_1')$  where  $R'$  is a radius of curvature of the micro-lens,  $n_1'$  is a effective refractive index of a medium along an optical path between the light generating region of the active layer and the micro-lens, and  $n_2'$  is a refractive index of a region toward which the light beam emits through the micro-lens,  $f$  is a distance from the light generating region to a vertex of the micro-lens along the optical axis. Since Lee's structure is identical to the claimed invention the VCSEL structure inherently satisfies the relationship above.

Regarding claims 52 and 53-54, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12 and 23 above including a forward biased current is applied to the micro-lens built-in VCSEL through the upper and lower electrodes, a laser beam comprising a particular wavelength through laser oscillation is transmitted through the

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lower reflector and the substrate and is condensed by the micro-lens and emitted as the parallel laser beam and the VCSEL is a bottom-emitting type VCSEL and the VCEL is a bottom-emitting type VCSEL (paragraph 0063 and fig. 7).

Regarding claims 54 and 55, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12 and 23 above including the window region comprises a maximum width smaller than a size of the light beam generated in the active layer emitted towards the window region. Since Lee's structure is identical to the claimed invention the VCSEL structure of Lee teaches the claimed invention.

Regarding claims 56, 57 and 61, Lee teaches substantially the entire claimed structure of claims 1-4, 5, 6-10, 12, 23 and 54 including the Fraunhofer diffraction condition of the window is offset by a focusing power of the micro-lens so that a parallel laser beam is emitted through the micro-lens the diameter  $D$  of the window and a focal length  $f$  of the micro-lens satisfy a following relationship:  $D = (2 \times 1.22 \Sigma f)^{1/2}$  where  $\Sigma$  is a wavelength of the light beam emitted from the VCSEL and also a following relationship:  $N_f = D^2 / \Sigma d \ll 1$ ; where  $N_f$  is a Fresnel number,  $\Sigma$ , is a wavelength of the light beam emitted from the VCSEL,  $D$  is the diameter of the window, and  $d$  is a distance from the window to an observing plane, which is one focal point of the micro-lens.

Since Lee's structure is identical to the claimed device the structure of Lee satisfies the Fraunhofer diffraction conditions as claimed.

Regarding claim 58, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12, 23 and 54 above including the high-resistance region between the upper and

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lower reflectors relatively close to the active layer, the high-resistance region comprises an aperture at the center thereof through which a current flows (fig. 6).

Regarding claim 59, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12, 23 and 54 above including the diameter of the window is smaller than or approximately equal to a diameter of the aperture of the high-resistance region (fig. 6).

Regarding claims 60 and 62, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12 and 23 above including the window and the micro-lens are positioned on a same plane (fig. 6).

Regarding claim 63, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12, 23 and 54 above when the micro-lens and the window are positioned on a same plane and only a  $O^{\text{th}}$ -order diffracted beam comprising a high intensity is considered, a radius  $R_s$  of the  $O^{\text{th}}$ -order diffracted beam satisfies a following relationship:  $R_s = 1.22\lambda d / D$  where  $\lambda$ , is a wavelength of the light beam emitted from the VCSEL,  $D$  is the diameter of the window, and  $d$  is a distance from the window to an observing plane.

Since Lee's structure is identical to the claimed device the Lee's structure satisfies the above relationship as claimed.

Regarding claim 64, Lee teaches the entire claimed structure of claims 1-3, 5, 6-9, 12, 23 and 54 above including the VCSEL is a top-emitting type VCSEL (fig. 7).

### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee.

Regarding claim 27, Lee teaches substantially the entire structure of claims 1-3, 5, 6-9 and 23 except explicitly stating that the aperture is small where the current applied through the upper electrode passes a region on the active layer and the light beam is generated in a dot-sized region of the active layer.

Parameters such as size of the aperture and the area of the light beam generated on the active layer in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired device characteristics.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the size of the aperture and the light beam area on the active layer as claimed in the combined structure of APA, Jiang and Evans in order to form a VCSEL structure with improved wavelength selection.

### ***Response to Arguments***

6. Applicant's arguments with respect to claims 1-64 have been considered but are moot in view of new grounds of rejection.

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***Conclusion***

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Samuel A. Gebremariam whose telephone number is (571)-272-1653. The examiner can normally be reached on 8:00am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SAG  
April 18, 2006



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